#1830

Mercury in Ambient Air Over Floodplain of East Fork Poplar Creek, Oak Ridge, Tennessee

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SUMMARY

As part of a CERCLA Remedial Investigation, ambient air concentrations of mercury were measured at several locations (Figure 1) in the floodplain of East Fork Poplar Creek, Oak Ridge, Tennessee, during late summer, early fall of 1991, and spring of 1992. The monitoring sites were selected to represent proximity to areas of known high soil contamination (up to 3000 $\mu g/g$) with mercury. Two independent methods of trapping and analyzing mercury in ambient air were employed. The more sensitive method involves amalgamating mercury vapor in ambient air on a gold-coated quartz medium. Mercury absorbed to these traps is desorbed (released) by heating and passed through a highly sensitive atomic fluorescence spectrophotometer. The method is sufficiently sensitive that only small volumes of ambient air need to be passed over the absorber prior to analysis. These absorbers are used for short term monitoring (minutes to hours). The second method employs iodated activated charcoal as the mercury-trapping medium. This medium is more difficult to analyze but has the advantage that the charcoal can trap enormous quantities of mercury without significant breakthrough. The charcoal must be digested in acids and then analyzed by atomic absorption spectrophotometry. This type of trap is used for long-term monitoring (days to weeks) and thus yields an average value for mercury over the collection period.

Air samples were collected on one afternoon (August 23, 1991) using the gold absorbers at three floodplain sites and at a control site atop Chestnut Ridge (Walker Branch Watershed). In addition, two floodplain sites (designated "NOAA" and "Minit Chek" on Figure 1) were monitored continuously over a 10-week period (August 23 through November 12) using the iodated charcoal absorbers which were changed on a weekly cycle. Finally, the NOAA site was resampled at two elevations above the soil using the gold absorbers on March 17, 1992. All concentrations (range: 3.1 to 12.4 nanograms/cubic meter) were very similar to levels expected in air at uncontaminated soil sites and far below the threshold level ($\geq$1000 ng/m^3) of human health concern (Table 1, Figure 2). The time trends of weekly average concentrations showed no difference between the monitoring sites but revealed a strong dependence on average weekly air temperature (Figure 2). Comparative data for Walker Branch Watershed for a recent extended monitoring period are summarized in Figure 3. The strong seasonal pattern in ambient air mercury concentrations is obvious in this graph and reflects the important dependance of mercury volatilization on temperature. Lastly, Figure 4 summarizes mercury concentrations in air over Reality Lake in the headwaters of East Fork Poplar Creek. This graph also shows a strong seasonal dependance and illustrates that even upstream where one might expect mercury to be higher in air over the creek, the observed concentrations are low and much less than the threshold level of human health concern.

ACKNOWLEDGEMENTS

The cooperation of landowners and land occupants was essential to the success of this investigation. Mr. Mel Sturm granted permission for us to operate a monitoring station on his property behind the Minit Check market. Mr. Rick Powers, manager of the Minit Check market, allowed us egress to the monitoring station and kindly provided (gratis) electrical power for our air pump. Dr. Detlef Matt of the NOAA Atmospheric Turbulence and Diffusion Laboratory provided assistance and electrical power for our monitoring site located behind this facility.

All iodated activated charcoal absorbers were analyzed by staff in the ORNL Analytical Chemistry Division. The authors appreciate the continuing high quality analytical service and support provided by these staff, including Marion Ferguson, Stan Macintyre and John Oliver. Jim Owens of the Environmental Sciences Division loaned us low flow air pumps and performed the analysis of the gold absorbers. Jim Hendershot of the Y-12 Industrial Hygiene Department also loaned us several low flow air pumps.

TABLE 1

Results of EFPC Air Monitoring Using Gold-Coated Quartz Absorbers

Location	Date	Time	Height (m)	Air Temperature	Soil Temperature	Mercury (ng/m^3)
NOAA	8/23/91	1100-1600	0.5	25°C	-	10.9
Lysimeter	8/23/91	1100-1600	0.5	25°C	-	5.9
Minit Chek	8/23/91	1100-1600	0.5	25°C	-	5.9
Walker Branch Watershed	8/23/91	1100-1600	0.5	25°C	-	5.1
NOAA	3/17/92	1500-1600	0.17	25°C	12°C	8.1±0.4
NOAA	3/17/92	1500-1600	1.7	25°C	12°C	8.0±0.5

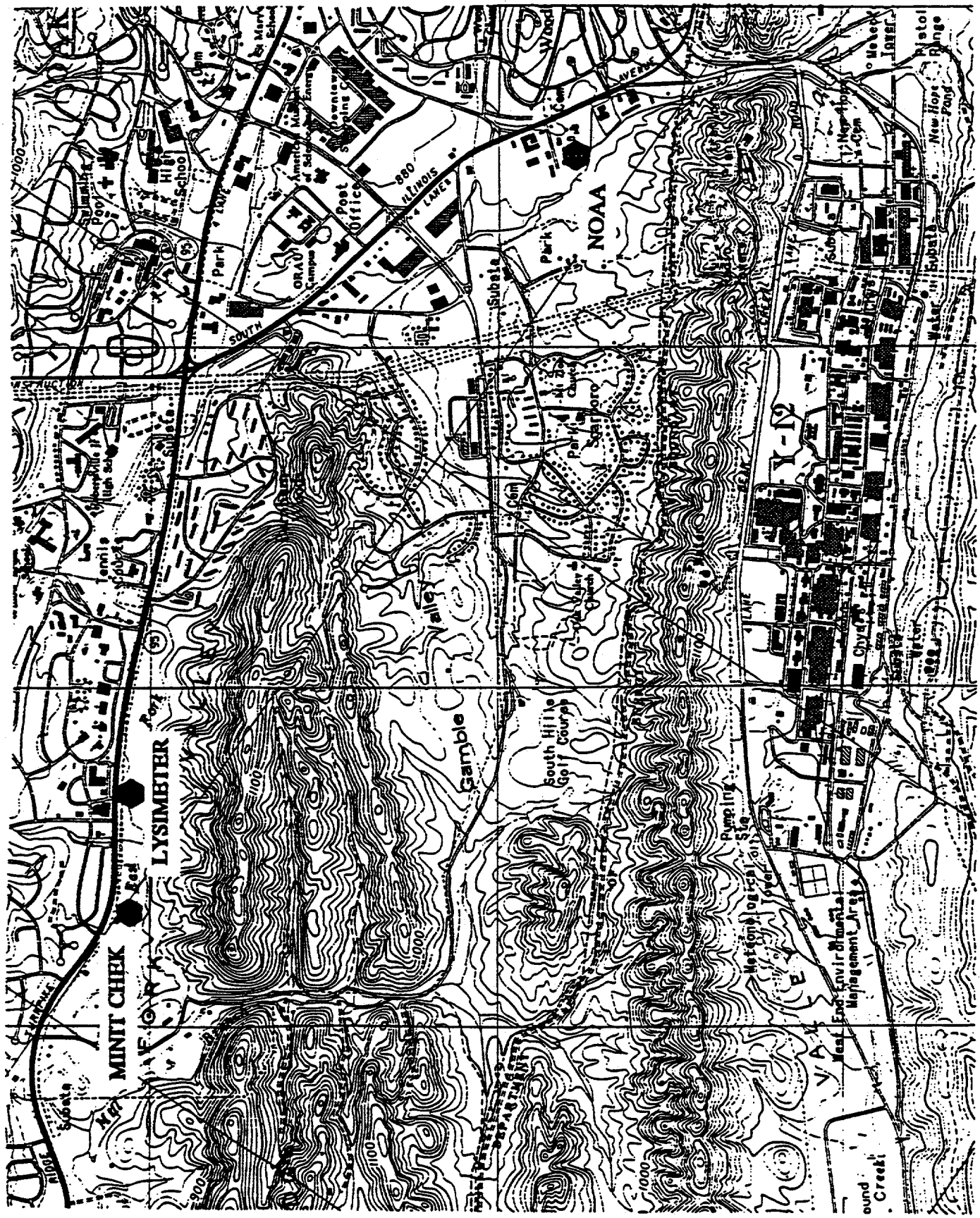

Figure 1 Locations of EFPC Floodplain Air Monitoring Sites

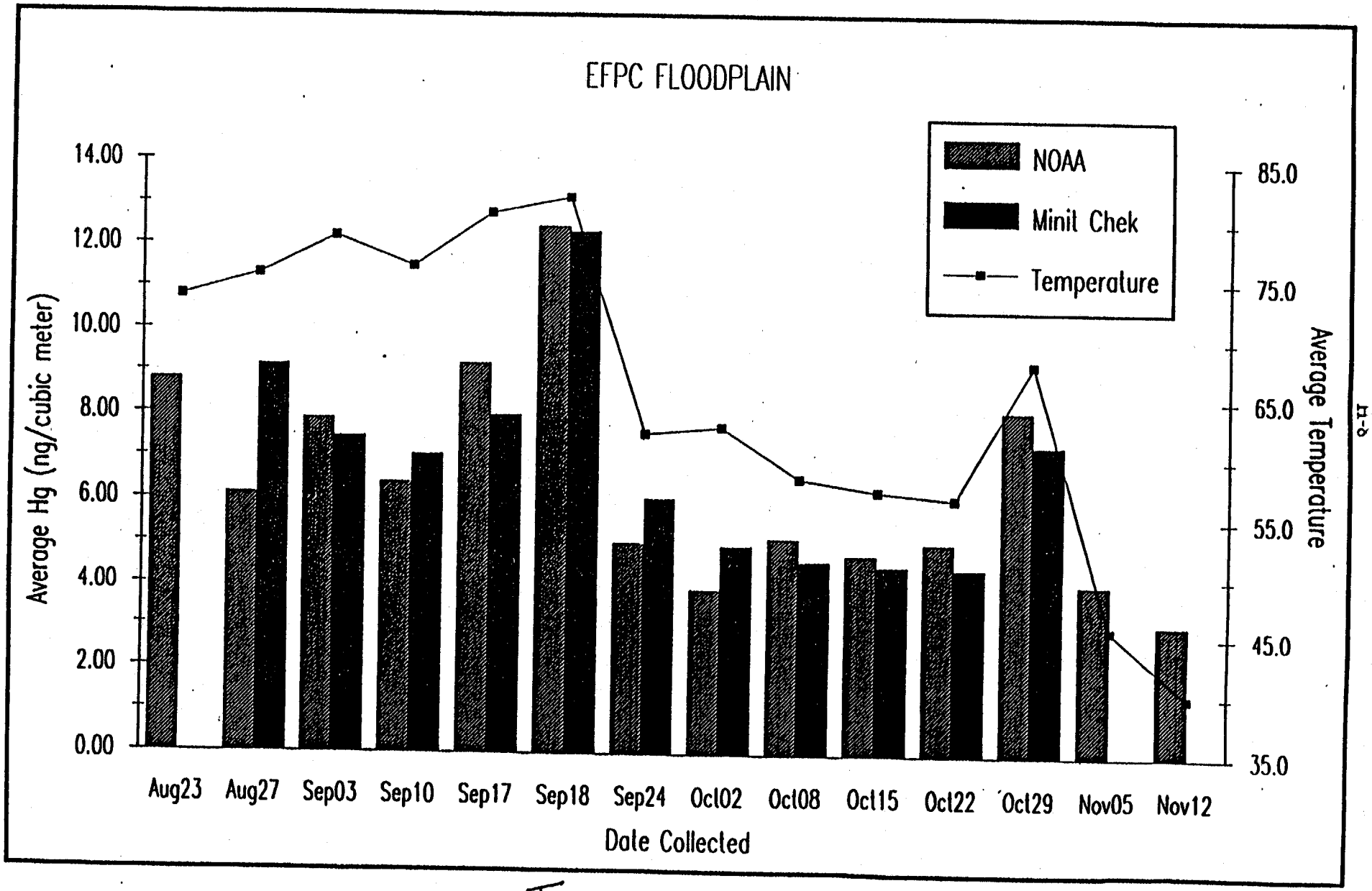
EFPC FLOODPLAIN
NOAA
Minit Chek
Temperature
Average Hg (ng/cubic meter)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Average Temperature
85.0
75.0
65.0
55.0
45.0
35.0
Aug23
Aug27
Sep03
Sep10
Sep17
Sep18
Sep24
Oct02
Oct08
Oct15
Oct22
Oct29
Nov05
Nov12
Date Collected

Figure 2

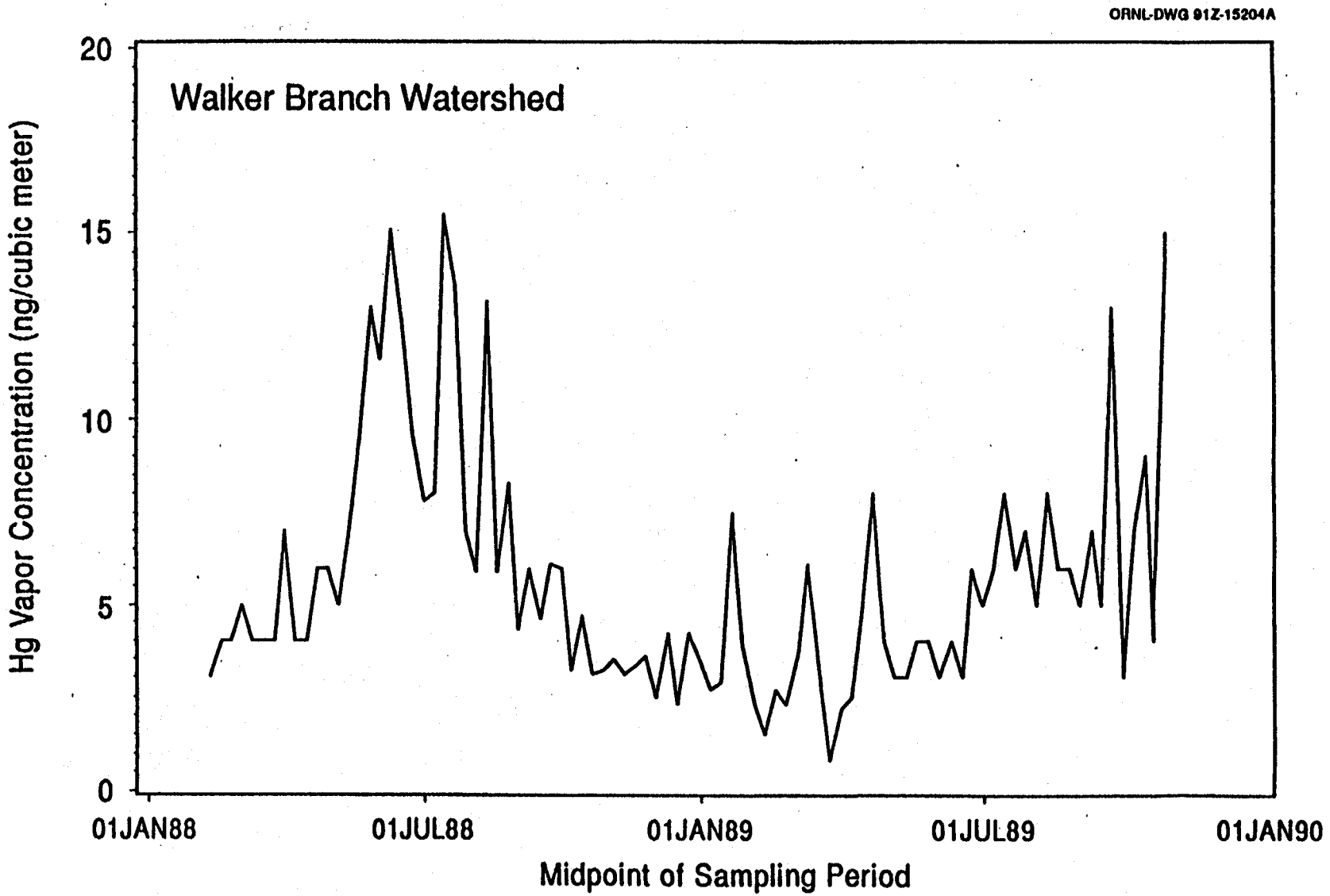
ORNL-DWG 91Z-15204A
Walker Branch Watershed
Hg Vapor Concentration (ng/cubic meter)
20
15
10
5
0
01JAN88
01JUL88
01JAN89
01JUL89
01JAN90
Midpoint of Sampling Period

Figure 3

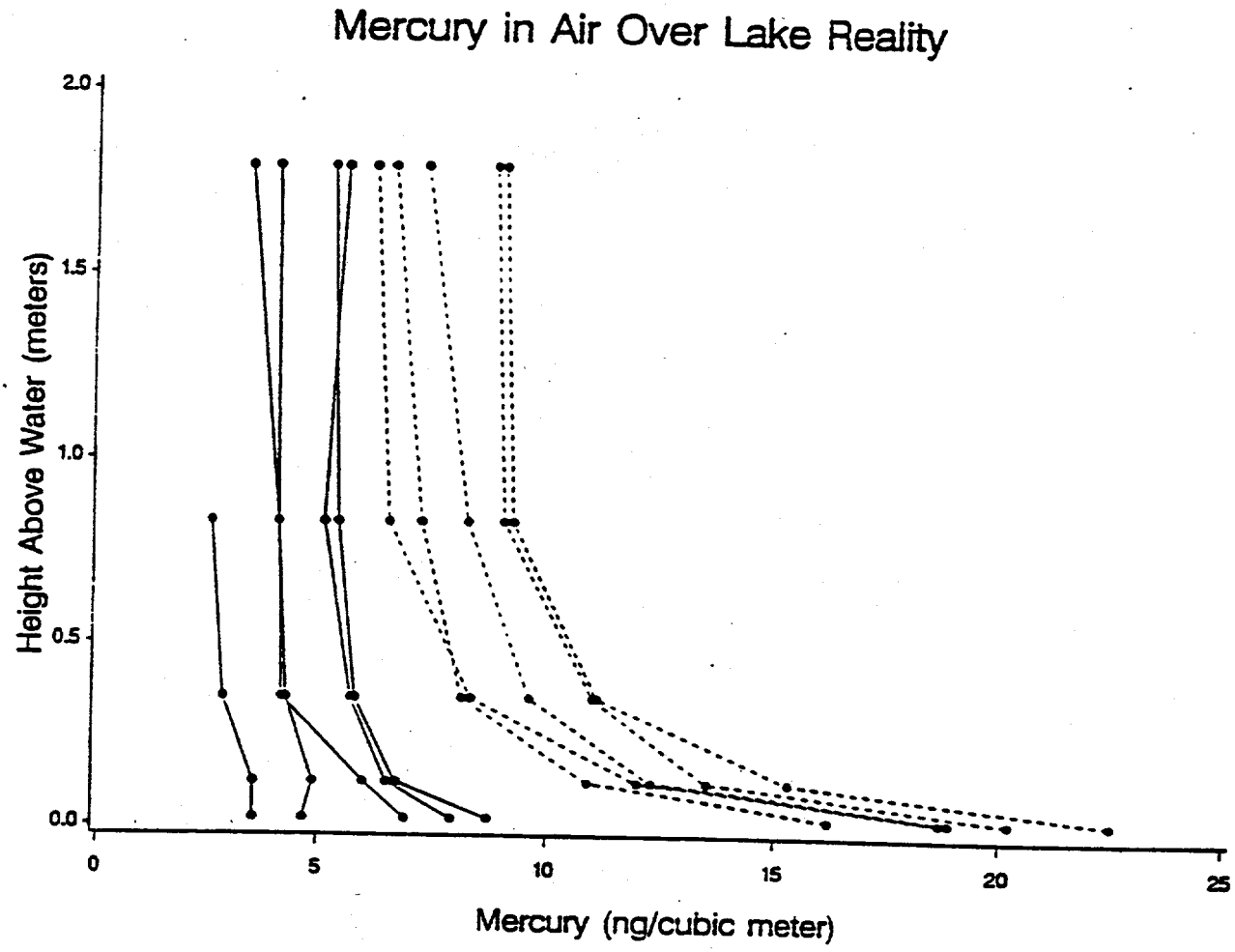

Fig. 4. Vertical concentration profiles in mercury in air over Reality Lake measured by sampling air at different heights over the lake using iodated activated charcoal absorbers. Each profile represents sampling over a 1-week period and thus integrates a variety of meterorological conditions. Profiles with solid lines were obtained between December, 1989 and February, 1990. Profiles with dashed lines were obtained between July and September 1990.